OOGENESIS IN HORMOSIRA

CONTRIBUTIONS FROM THE HULL BOTANICAL LABORATORY 193

M. R. GETMAN

(WITH PLATE XX AND SEVEN FIGURES)

The genus *Hormosira* is placed by OLTMANNS (7) under the Fucaceae and classified with *Notheia* in the family Anomalae, characterized by him as a group of small and perhaps reduced forms. The genus is fully described and illustrated by HARVEY (giving DECAISNE as authority) in his *Phycologia Australica* (3). The larger plant he names *H. Banksii* var. *Labillardieri* or *Billardieri* (fig. 1), and the smaller, *H. Banksii* var. *Sieberi* or *obconica* (figs. 2 and 3). HOOKER (quoting ENDLICHER) in the *Handbook of New Zealand flora* (4) describes the same forms, naming the first *H. Billardieri* var. *Labillardieri*, and the second, var. *Sieberi*.

The material used in this study was collected by Dr. C. J. CHAMBERLAIN at Avoca, near Sydney, on the eastern coast of Australia. It occurs in the tide pools and on rocks where it is constantly exposed to the dashing of salt spray.

The plant varies in color from an orange-brown to an olive-green. It has no differentiation into parts, but is merely a chain or "necklace" of swollen vesicles or bladders which bear the conceptacles. HOOKER refers to the plant as a series of internodes (the inflated portions) alternating with smaller narrower parts (the nodes). The development, according to GRUBER (2), is from four apical cells. Branching commonly occurs at the internodes, but it may take place at the nodes. It is usually dichotomous, but cases of trichotomy are common, and even polychotomy has been observed. Each internode, excepting the one at the base, contains a central cavity. In fresh material threads may be seen extending from the base to the top of this cavity. The internode consists of an external mucilaginous layer varying in thickness depending upon the age of the plant and the position of the internode. This epidermis or outer layer BOWER (1) prefers to call

limiting tissue. Underneath lies the cortex, and beneath this a thick mass of anastomosing filaments, termed irregular tissue by

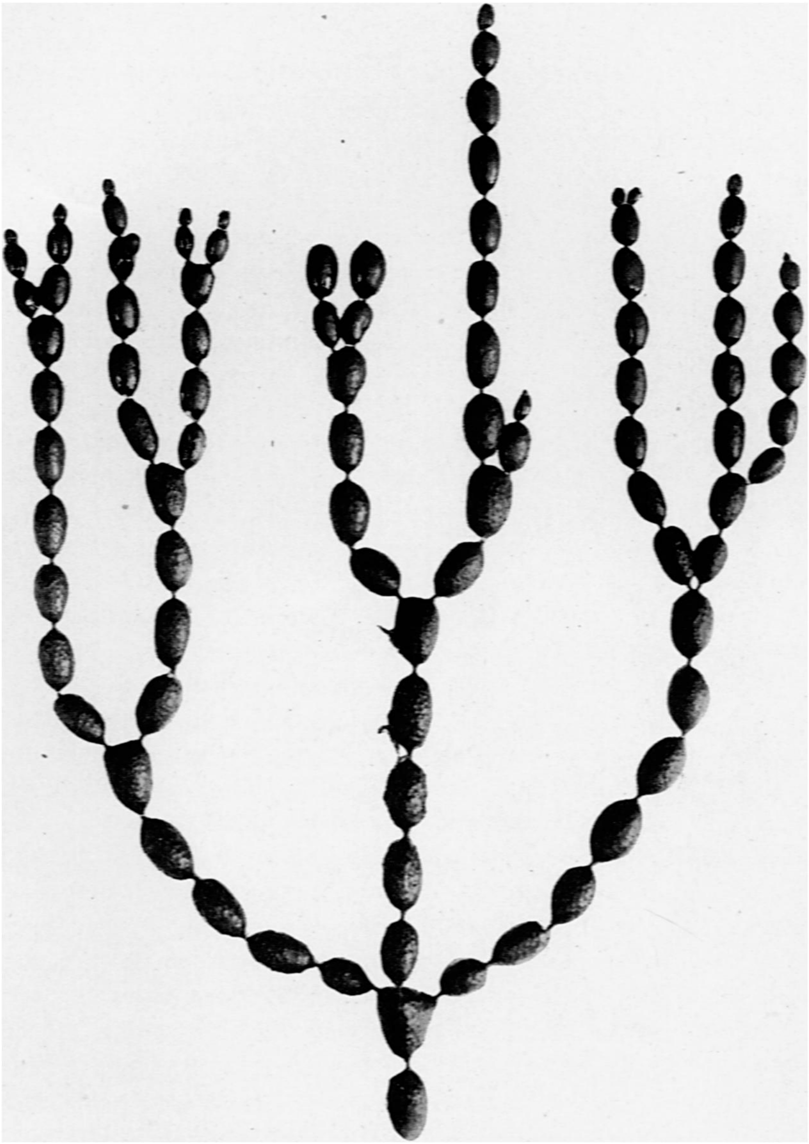

FIG. 1.—*Hormosira Banksii* var. *Labillardieri*

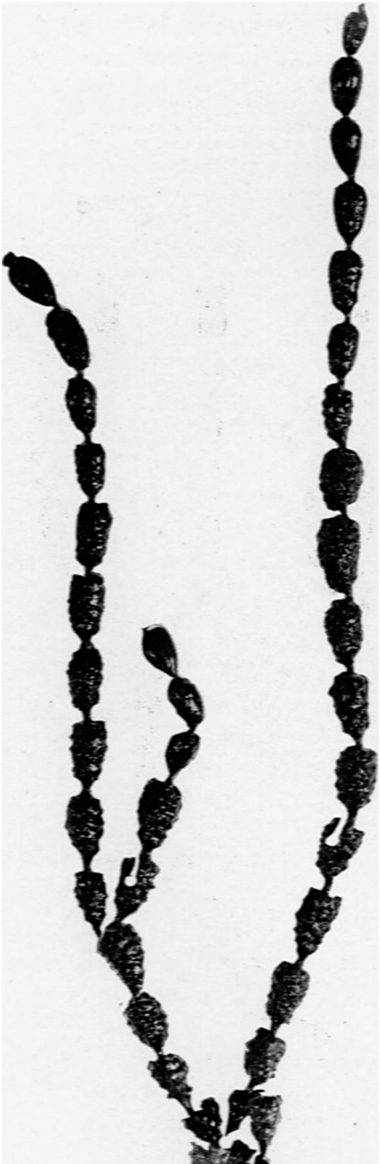

FIG. 2.—*Hormosira Banksii* var. *Sieberi:* mature oogonial plant.

MOLLET (6). These cells are very gelatinous and are limited below by a layer of parallel cells (fig. 4).

There is no cavity in the node. An epidermis and cortical layer are both present, and its center is made up of parallel cells, which divide into two strands as they pass into the internode below. At the distal end of the node there seems to be a decrease in parallel cells as they merge into the anastomosing filaments (fig. 5).

The plant is dioecious. The antheridial plants are readily recognizable on account of the bright orange color. The conceptacles are flask-shaped, and are sunken in the outer tissues of the internode. From the few observations made of the conceptacle, the development seems to tally with BOWER'S account (1) of its development in the Fucaceae, where the basal cell (*b*) and adjoining cells contribute to the growth of the conceptacle. In the figure, BOWER'S "initial cell" shows a nucleate stage (fig. 6). A later stage of the conceptacle furnishes characteristic paraphyses (fig. 7), a few of which may persist in the mature oogonial conceptacle, but whose place is taken almost entirely by hairs of a different nature.

It will be recalled that the several genera of the Fucaceae, in their oogenesis, present an interesting illustration of recapitulation. Of the members of this family which have been investigated, all except *Sargassum* show three mitoses in the oogonium, resulting in the formation of eight nuclei. In the genus *Fucus*, all the nuclei are centers for the formation of the eggs. In another genus,

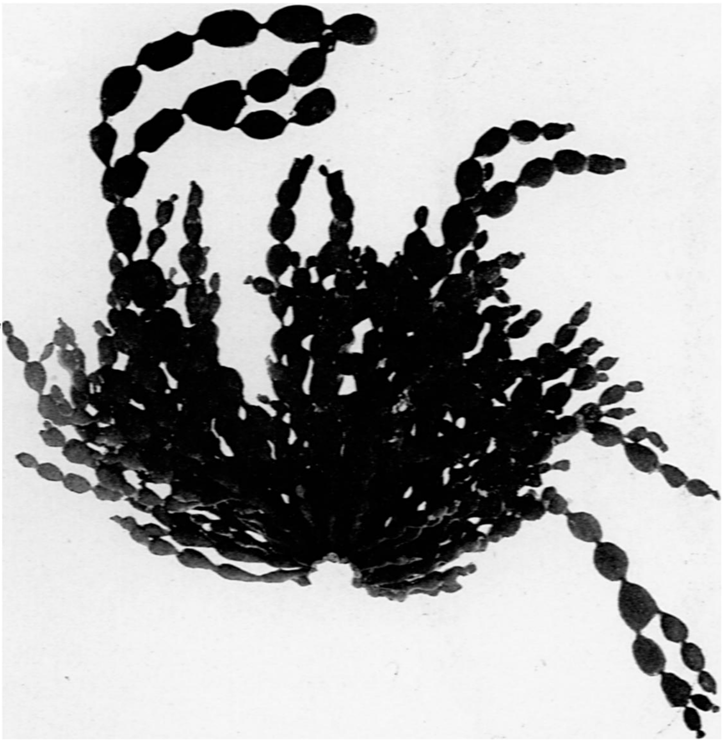

FIG. 3.—*Hormosira Banksii* var. *Sieberi:* young plants

Ascophyllum, OLTMANNS found four functional eggs. In *Pelvetia* he found that only two eggs mature and that the other six nuclei abort. In *Himanthalia*, OLTMANNS (8) found only one egg, and YAMANOUCHI has observed the same condition in *Cystosira*. In both cases the other seven nuclei degenerate. In *Sargassum filipendulum*, Miss SIMONS (9) finds no mitosis after the formation of the oocyst, and therefore the $2x$ number of chromosomes should

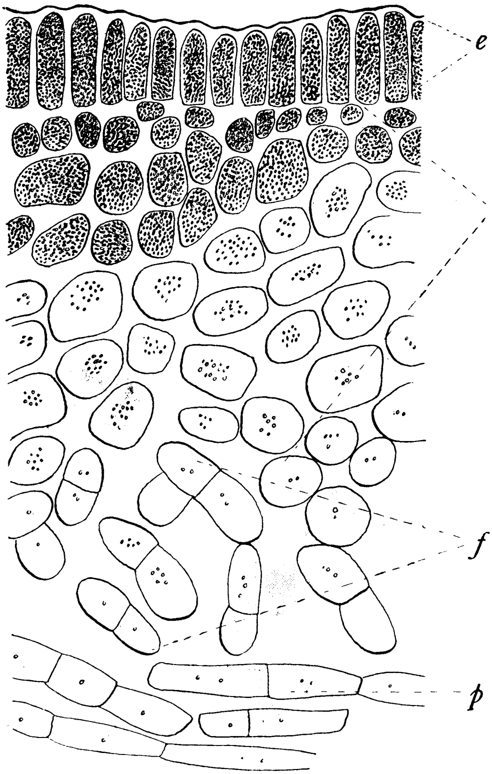

FIG. 4.—Portion of an internode: *e*, limiting tissue or epidermis; *c*, cortex; , anastomosing filaments; *p*, parallel tissue; ×250.

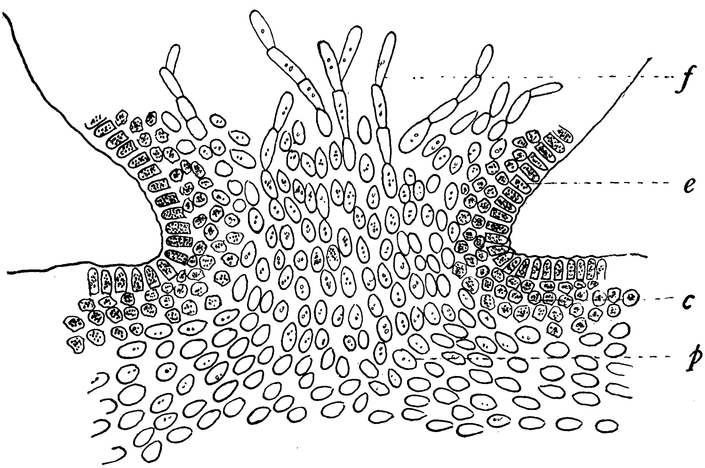

FIG. 5.—Structure of a node: *e*, epidermis; *c*, cortex; *f*, anastomosing filaments; *p*, parallel tissue; ×85.

be present in the egg. Since there has been no reduction division, the three mitoses characteristic of oogenesis in *Fucus* have been suppressed in *Sargassum*. However, out of the large number of conceptacles examined in this form, one oogonium was found which contained two eggs and two oogonia that contained eight; this was regarded as a rare reversion to the *Fucus* type. The above instances in oogenesis form a series beginning with the eight eggs of *Fucus* and ending with the parthenogenetically developed egg of *Sargassum*. Oogenesis in *Fucus* is regarded as the primitive type and the others as reductions from it.

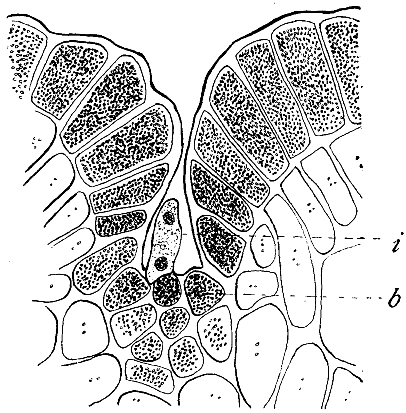

FIG. 6.—Conceptacle: *a*, BOWER's "initial"; *b*, "basal" cell; ×480.

OLTMANNS, KUTZING, and GRUBER have all mentioned the ultimate formation of four eggs in *Hormosira*, but no investigation has been made of the conditions of oogenesis.

The material was fixed in Flemming's weaker solution with the osmic acid a little weaker than the formula requires. As in OLTMANNS' account of *Ascophyllum*, simultaneous free nuclear division takes place, resulting in 2-nucleate, 4-nucleate, and 8-nucleate stages (figs.

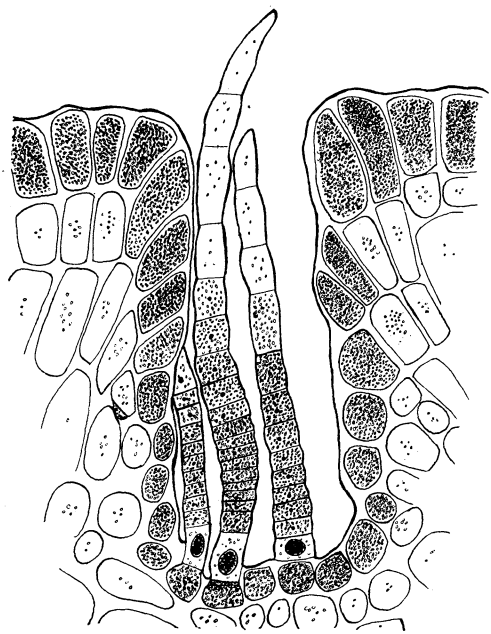

FIG. 7.—Conceptacle: first formed paraphyses; ×410.

8–10). Thus far, the conditions seem the same as for *Ascophyllum*. After this the account differs, for the coming in of walls was observed in many cases. For instance, a rather unusual case is the occurrence of seven nuclei, and the division into three parts by two horizontal walls (fig. 11). The coming in of a vertical wall after the formation of a single horizontal one is also found (fig. 12). The most usual situation seems to be a blocking out by walls of the nuclei and the plastids (fig. 13). Here six such characteristic groups can be seen and also a seventh nucleus. Rarely (fig. 14) four eggs are formed and eight nuclei are present. This may be a situation immediately preceding that presented in fig. 15, or the walls shown in fig. 13 may have disintegrated, leaving only the primary walls. No spindles were seen to account for the formation of the walls. They may have been formed by cleavage as does happen among certain of the algae and fungi.

While the details of oogenesis remain to be investigated in several genera of the Fucaceae, it seems certain that the 8-nucleate condition followed by eight functioning eggs is primitive, and that most of the genera which form less than eight eggs pass through this stage.

This study of *Hormosira* shows that not only are eight nuclei formed, but eight eggs begin to develop, so that the final 4-nucleate condition is reached by the breaking down of four immature eggs rather than of four free nuclei. Such a condition is safely interpreted as less removed from the *Fucus* condition than forms in which the 4-nucleate stage is reached by the breaking down of free nuclei.

I am very much indebted to Dr. C. J. CHAMBERLAIN under whose direction the work was done, and to Dr. W. J. G. LAND for the photographs in the text.

UNIVERSITY OF CHICAGO

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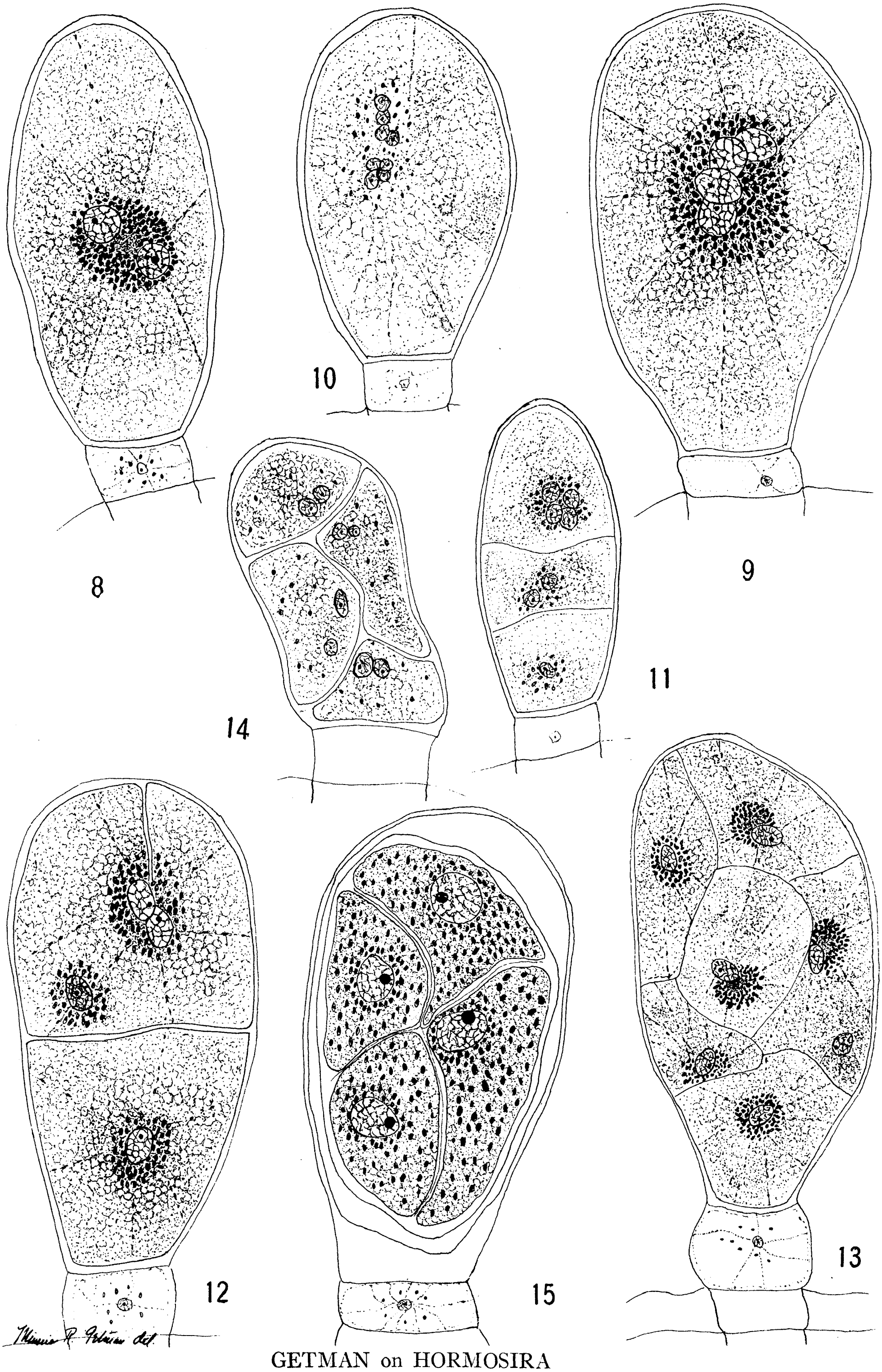

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EXPLANATION OF PLATE XX

FIGS. 1–7 are text cuts. All figs. of the plate ×480.

FIGS. 8–10.—Free-nucleate condition.

FIGS. 11, 12.—Development of walls.

FIG. 13.—Blocking out of six eggs; a seventh nucleus showing.

FIG. 14.—Four eggs and eight nuclei; the four other eggs have degenerated.

FIG. 15.—Four mature eggs.